

Assuming that the 0-10 volt input is at 5 volts, it can be seen in graph 8A that the digital pulse 150 is high until voltage on Pin 6 reaches 5 volts, point 151, and then goes low until the ramp voltage reaches 10 volts when capacitor 143 is discharged, point 153 when it goes high again and the cycle starts over. Thus, if the 0-10 volt input is 5 volts, the duty cycle at the output Pin 7 of comparator 138B is a 50/50. In the same manner if the 0-10 volt input is at 7 volts the duty cycle of the digital output will be 30/70 as shown in Figure 8 pulses 156 and 157.

The 0-10 volt system used in the market today requires that each ballast source some current as the controller is a current sink that maintains a fixed voltage regardless of the current it is sinking. This current is sourced by resistor 132 which is connected to the +12 volt isolated supply. Opto isolator 131 is a conventional device with a light emitting diode (LED) connected between Pins 1 and 2. The light turns on a diode or photo transistor connected between Pins 4 and 3. Thus isolation is achieved. Resistor 144 sets the amount of current that flows in the LED. When the 0-10 volt input is not connected resistor 132 pulls Pin 6 on comparator 138B above 10 volts thus the output on Pin 7 never goes low. Since this output is an open collector it is effectively disconnected from the circuit. Pulse width modulation (PWM) is connected directly to the opto isolator to achieve the same result in controlling the ballast.

Although the present invention has been described in connection with preferred embodiments thereof, many variations and modifications will now become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited, not by the specific disclosure herein, but only by the appended claims.

I CLAIM:

1. A gas discharge lighting system comprising:
 - one or more gas discharge lighting devices;
 - a source of input power;
 - a electronic ballasting circuit having a regulated direct current requirement coupled between said gas discharge lighting device and said source of input power comprising:
 - an alternating-to-direct current conversion means;
 - a power regulator connected to said alternating-to-direct current conversion means for converting its output to said regulated direct current required to operate said ballasting circuit;
 - a controllable output direct current to alternating current inverter that operates with a nearly square wave output at a frequency above that of audible sound;
 - an impedance network interposed between said inverter and said gas discharge lighting devices consisting of at least one resonating inductor and capacitor to modify the square wave output of said inverter to provide proper operation of said gas discharge lighting devices;
 - and
 - a controlling device that controls the operation of said inverter and thus, via said impedance network, the amount of power delivered to said gas discharge lighting devices.

2. A gas discharge lighting system as set forth in claim 1 further comprising :

a low voltage direct current power supply to provide power to said controlling device as well as switching power to said controllable output direct current to alternating current inverter;

a switching device connected to the output of said alternating-to-direct current conversion means to source power to said low voltage direct current power supply when operation first commences; and

an additional winding on said resonating inductor with its output rectified to produce direct current to supply said low voltage direct current power supply after operation has commenced with said switching device, that is connected to the output of said alternating-to-direct current conversion means, biased into the non conduction mode by the rectified output of said additional winding on said resonating inductor.

3. The gas discharge lighting system as set forth in claim 2 wherein said controlling device is a microprocessor coupled to said gas discharge devices to monitor their operation and interconnected with said controllable output direct current to alternating current inverter to control the output to said gas discharge devices.

4. The gas discharge lighting system as set forth in claim 2 further comprising:

a second additional winding on said resonant inductor electrically isolated from all other windings;

a full wave rectifying means connected to said second additional winding to produce an isolated direct current; and

a regulator circuit to receive said isolated direct current and produce a regulated isolated direct current supply.

5. The gas discharge lighting system as set forth in claim 4 including a voltage to pulse width modulation conversion circuit connected to said regulated isolated supply of direct current for the conversion of an input voltage varying between zero to ten volts to an alternating current square wave which has an on to off time ratio proportional to the level of the zero to ten volt input.

6. The gas discharge lighting system as set forth in claim 5 wherein said voltage to pulse width modulation conversion circuit comprises:

a PNP bipolar transistor configured with a first resistor connected between said isolated direct current supply and the emitter of said PNP bipolar transistor;

a second and third resistor connected in series between the isolated direct current supply and its common terminal, the second and third resistor values chosen to have 10 volts at their junction, said junction connected to the base of said PNP bipolar transistor;

a first comparator with its negative input connected through a forth resistor to the collector of said PNP bipolar transistor and its positive input connected to the junction of said second and third resistors, the output of said first comparator connected to the collector of said PNP bipolar transistor;

a first capacitor connected between the junction of the collector of said PNP bipolar transistor and said forth resistor and said isolated direct current supply's common, said capacitor charges at a constant rate from the constant current flowing from the collector of said PNP bipolar transistor until it reaches a level of ten volts which causes said first comparator's output to go low discharging said first capacitor via said connection for first comparator's output to the collector of said NPN bipolar transistor;

a second capacitor connected to the negative input of said first comparator and isolated direct current supply's common to assure that said first comparator stays on long enough to fully discharge said first capacitor; and

a second comparator with its negative input connected to the output of said first comparator and thus presenting a saw tooth zero to ten volt wave at said second comparator negative input, the second comparator positive input connected to said zero to ten volt input with the output of said second comparator going high or low depending on whether the voltage at said negative input is above or below said zero to ten volt input presented at said second comparator's positive input.

7. A gas discharge lighting system as set forth in claim 1 further comprising:

a heater transformer with its primary effectively connected across said impedance network's connection to said gas discharge lighting devices;

secondary windings as required to drive one or more heaters within said gas discharge lighting devices incorporated as part of said transformer.

a low voltage direct current power supply to provide power to said controlling device as well as switching power to said controllable output direct current to alternating current inverter;

a switching device connected to the output of said alternating-to-direct current conversion means to source power to said low voltage direct current power supply when operation first commences;

an additional winding on said heater transformer with its output rectified to produce direct current to supply said low voltage direct current power supply after operation has commenced with the said switching device, connected to the output of said alternating-to-direct current conversion means, biased into the non conduction mode by the rectified output of said winding on said heater transformer.

8. The gas discharge lighting system as set forth in claim 7 wherein said controlling device is a microprocessor coupled to said gas discharge devices to monitor their operation and interconnected with said controllable output direct current to alternating current inverter to control the output to said gas discharge devices.

9. The gas discharge lighting system as set forth in claim 7 further comprising:

a second additional winding on said heater transformer electrically isolated from all other windings;

full wave rectifying means connected to said second additional winding to produce an isolated direct current; and

a regulator circuit to receive said isolated direct current and produce a regulated isolated direct current supply.

10. The gas discharge lighting system as set forth in claim 9 wherein said voltage to pulse width modulation conversion circuit comprises:

a PNP bipolar transistor configured with a first resistor connected between said isolated direct current supply and the emitter of said PNP bipolar transistor;

a second and third resistor connected in series between the isolated direct current supply and its common terminal, the second and third resistor values chosen to have 10 volts at their junction, said junction connected to the base of said PNP bipolar transistor;

a first comparator with its negative input connected through a fourth resistor to the collector of said PNP bipolar transistor and its positive input connected to the junction of said second and third resistors, the output of said first comparator connected to the collector of said PNP bipolar transistor;

a first capacitor connected between the junction of the collector of said PNP bipolar transistor and said fourth resistor and said isolated direct current supply's common, said capacitor charges at a constant rate from the constant current flowing from the collector of said PNP bipolar transistor until it reaches a level of ten volts which causes said first comparator's output to go low discharging said first capacitor via said connection for first comparator's output to the collector of said NPN bipolar transistor;

a second capacitor connected to the negative input of said first comparator and isolated direct current supply's common to assure that said first comparator stays on long enough to fully discharge said first capacitor; and

a second comparator with its negative input connected to the output of said first comparator and thus presenting a saw tooth zero to ten volt wave at said second comparator negative input, the second comparator positive input connected to said zero to ten volt input with the output of said second comparator going high or low depending on whether the voltage at said negative input is above or below said zero to ten volt input presented at said second comparator's positive input.